DOCUMENT RESUME

ED 173 356 TM 008 351

AUTHOR Webster, Raymond E.
TITLE Information-Processing Variables in the Assessment of School Related Learning Problems.
PUB DATE Aug 78
NOTE 12p.; Paper presented at the Annual Meeting of the American Psychological Association (86th, Toronto, Ontario, Canada, August 28-September 1, 1978)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Ability; *Cognitive Processes; Cognitive Tests; *Diagnostic Tests; *Intelligence; *Intelligence Tests; *Memory; *Screening Tests; Student Placement; Verbal Learning
IDENTIFIERS *Short Term Memory

ABSTRACT

Currently, the reliance on intelligence tests as the primary criterion for the placement of children in school programs has been challenged. Much of the controversy focuses on the insensitivity of these instruments to individual cognitive styles for different subgroups of children. While the issue of whether intelligence tests measure skill deficits or content deficiencies has not yet been resolved, it is clear that these instruments fail to delineate the specific mental processes involved in verbal and nonverbal performance. It is argued that a diagnostic procedure which attempts to determine how efficiently a child processes different kinds of information could provide a more meaningful assessment of the child's capabilities for learning new verbal material. This assessment would minimize cultural and racial bias, because it emphasizes a person's information-processing strategies without regard to norm-referenced criteria. This paper reviews the role of short-term memory (STM) in academic achievement and performance, and describes a sense of alternative diagnostic procedures which evaluate the child's capacity for acquiring and storing different types of verbal information in STM. Three areas are reviewed: (1) STM capacity; (2) decay and interference effects in STM; and (3) retrieval from STM. (Author/RD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED173356

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Information-Processing Variables in the Assessment of School Related Learning Problems*

Paper presented at the 86th Annual Meeting of the Americal Psychological Association, Toronto
August 28 - September 1, 1978

Raymond E. Webster[1]

Department of Educational Psychology
University of Connecticut

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Raymond E. Webster

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

*Preparation of this paper was aided in part by a grant from the Bureau of Education for the Handicapped, "Learning Disabilities in Mathematics: A Curriculum Design for Upper Grades," U.S. Office of Education, Grant No. G007605223, under the direction of John F. Cawley, The University of Connecticut, Storrs.

[1]Currently Director of Special Services, Northeastern Area Regional Educational Services, P.O. Box 436, Wauregan, Connecticut 06387

TM008 351

Information-Processing Variables in the Assessment of School Related Learning Problems

Much of the current controversy about reliance on intelligence tests as the primary criterion for the placement of children in various school programs generally focuses on the insensitivity of these instruments to individual cognitive styles for different subgroups of children. Intelligence tests were developed with the intent of distinguishing between individuals with low cognitive ability and those with higher ability and potential. In recent years, these tests have also been used to define areas of cognitive skill strengths and deficits.

While the issue of whether intelligence tests measure skill deficits or content deficiencies is not resolved (Cawley, 1977), it is clear that these instruments fail to delineate the specific mental processes involved in verbal and non-verbal performance. Further, it appears that these instruments have limited discriminative efficacy in differentiating among children of dull normal and higher intelligence who exhibit different types of learning problems in school. Webster, Schenck and Kahn (1977) analyzed the test performance patterns on the WISC or WISC-R and the WRAT of 1,596 children between the ages of 6 years, 0 months and 17 years, 0 months who had been labeled as either learning disabled, emotionally disturbed, educably mentally handicapped, physically handicapped, or multi-handicapped (exhibiting two or more of these disabilities in combination) by school special services personnel. Using a series of discriminant functions analyses, it was found that as many as 85.60% of non-learning disabled labeled children were predicted to be learning disabled on the basis of

these test data. Either these instruments are ineffective in distinguishing among these types of disabilities, or they are being used inappropriately in making diagnostic decisions. At any rate, there seems to be an unclear relationship between the diagnostic label assigned to a child and that child's test performance patterns on standardized intelligence and achievement tests.

The purpose of norm-referenced instruments such as the WISC-R is to maximize variation of performance among individuals. These instruments were not developed with the intent of delineating an individual's specific behavioral and/or psychoeducational strengths and deficits. Subsequently, these data demonstrating the lack of diagnostic usefulness of the WISC-R, the ITPA (Newcomer and Hammill, 1977), the Detroit Tests of Learning Aptitudes (Bruininks, 1969; Nelson and Hudson, 1969), and the Bender Visual-Motor Gestalt Test (Critchley, 1970; Pick, 1970; Rosen, 1966) are not surprising or incomprehensible.

A diagnostic procedure which attempts to determine how efficiently a child processes different kinds of information could provide a more meaningful assessment of the child's capacities for learning new verbal material. This type of diagnostic assessment would minimize cultural and racial biases because it emphasizes the individual's information-processing strategies without regard to norm-referenced criteria. Data about a child's short-term learning capacity and efficiency would have direct relevance to the implementation of instructional alternatives and techniques. Certainly, this direct relationship between the diagnostic assessment and the development of an instructional program for the atypical learner is encouraged under the regulations of P.L. 94-142.

The purposes of this paper are to briefly examine the role of short-term memory (STM) in academic achievement and performance, and to describe

a series of alternative diagnostic procedures which evaluate the child's capacity for acquiring and storing different types of verbal information in STM.

The role of STM in successful academic achievement has been long recognized (Blankenship, 1938). STM serves to either hold newly acquired information until it is processed into long-term storage, or to hold previously acquired information retrieved from long-term stores for use in the present. STM capacity and initial processing efficiency seem to be important parameters which constrain rapidity of new learning (Bjork, 1972; Miller, 1956), the ability to generate new ideas, and the capacity to integrate and conceptualize newly learned information with previously acquired knowledge (Klausmeier, Ghatala and Fraser, 1974). The role of impaired STM capacity has been demonstrated in reading disabilities (Goyen and Lyle, 1973; Samuels and Anderson, 1973; Haber, 1970), verbal language deficits (Merikle, 1969; Graham, 1968), concept learning (Klausmeier, Ghatala and Fraser, 1974), symbolic language disorders (Kirk, 1971; Shedd, 1968; Johnson and Myklebust, 1965), and mathematics disabilities (Webster, 1978). Senf and Freundl (1971) and Senf (1969) have demonstrated that learning disabled children exhibit deficits in the sequential organization of information within STM stores. Shankweiler and Liberman (1976) have shown that good readers may be distinguished from inadequate readers on the basis of STM capacity for phonologically confusable and non-confusable strings of consonants. Finally, memory deficits have been shown to be a significant factor constraining the learning capacity of mentally retarded individuals (Brown, Campione and Murphy, 1974; Ellis, 1970).

The assessment of information-processing efficiency in STM involves determination of (1) STM capacity under different modality input conditions and for various kinds of stimulus items; (2) how rapidly

information is lost from STM storage and the effects of verbal interference on STM recall capacity; and (3) efficiency of retrieval of information from STM storage.[1]

STM Capacity

STM capacity will indicate how much information the child can accurately store and access. It has direct relevance to the comprehension of both visual and aural instructions, reading comprehension, and sequential organization of arithmetical computations, especially in multiplication and division. Even in reading or daily discourse, where one can extract and paraphrase the gist of a message, the correct rote sequential organization of facts is essential.

Determination of STM capacity should be accomplished using both successive and simultaneous presentation of stimulus items for the visual modality. Successive presentation is possible only for the auditory modality. Successive presentation permits assessment of how the child stores information presented sequentially as individual bytes or chunks. The resultant STM capacity, as determined by the length of the longest serial string correctly recalled, indicates the maximum load of information which can be efficiently and accurately processed. Confusion of the correct serial order suggests a deficit in the sequential organization of information in STM. Comparison of visual and aural recall performance will provide information about the child's modality-specific learning preferences and strengths.

Serial strings should range from two to nine items in length. The individual stimulus items should be comprised from the following non-rhyming

[1]More specific information concerning the theoretical rationale and corresponding experimental evidence in these areas may be found in Baddeley (1976), Crowder (1976), and Murdock (1974).

consonants: F, H, K, L, M, P, Q, R, S, W, X and Y. Experimental evidence has shown that serial strings of letters made of acoustically similar consonants (for example, B, C, D, G, T, V, Z) produce substantially lower recall performance (Shankweiler and Liberman, 1976).

Serial strings may also be comprised of CVC, CVVC, or CCVC real words both familiar and not familiar to the child. This same format may be used with nonsense words. Use of these types of stimuli will provide data about the child's efficiency in processing and storing larger chunks of information. The rate of presentation is one item per second.

The simultaneous presentation of items (consonants, real words, or nonsense words) in the visual modality provides a measure of the amount of information a child can visually apprehend at one time. The total presentation exposure time is calculated on the basis of one second for each item (letter or word) in the array.

Decay and Verbal Interference Effects in STM

In the typical learning situation, the presentation of new information is usually followed by varying amounts of verbal interference. In order to assess how much material a child is capable of retaining under these conditions, some estimate of how quickly information is lost from STM as a function of verbal interference is required.

The rapidity of decay of information from STM storage can be measured by use of an experimental technique devised by Brown (1958) and extended by Peterson and Peterson (1959). The child is either shown for two seconds, or verbally given, a consonant trigram (for example, KMQ). Upon termination of the trigram, a retention interval varying from trial to trial is imposed by the examiner. This retention interval can range from 1 to 16 seconds, and may be increased in increments of three seconds. To

prevent covert rehearsal of the stimuli, the child is given an intervening verbal interference task. Most frequently, this task consists of orally counting backwards by twos or threes from some arbitrary number. At the conclusion of this interval the child is asked to state the trigram. The number of letters correctly recalled is an index of the amount of information remaining in STM storage. Variation of this interval will indicate at which point in time a child loses the greatest amount of newly acquired information.

In this procedure, both the nature and length of the stimuli can be varied. Stimulus items can include real or nonsense words or meaningful sentences. Further, the nature of the intervening verbal task may also be varied.

Retrieval from STM

The final area of information-processing which is integral to the assessment of learning efficiency is facility in retrieving material from STM storage. This may be assessed using a technique developed by Sternberg (1966, 1969). A serial string of consonants, real words, or nonsense words is presented visually or aurally. The length of the list should be one or two less than the child's maximum recall capacity. Termination of the stimuli is followed by a three second delay. The examiner then either states or shows the child a probe item, which may or may not be a member of the original array. The child merely states 'yes' if the probe is a member of the original list, or 'no' if it is not a member. The variables of interest are the reaction time required to produce the response and the accuracy of the response. The greater the response latency, the longer the child requires to retrieve information from STM storage.

Concluding Remarks

The use of a diagnostic procedure which examines the information-processing strategies involved in learning provides a more meaningful assessment of the conditions which facilitate or impede a child's acquisition of new knowledge. The most significant advantage of this procedure is that it can be used as a content-free instrument which assesses behavioral deficits. The three behaviors measured are serial recall in STM, decay and the effects of verbal interference on STM recall, and retrieval of information from STM storage. The content of the stimulus items can range from that which is familiar socially and personally to the child, to nonsense words or sentences which have no standardized meaning. As such, an important differentiation can be made between children who exhibit mere content deficiencies and those who have a pure behavioral learning deficit [(i.e.) ineffective processing for verbal material]. One of the major criticisms directed at intelligence tests as currently used is that they really measure content deficiencies rather than behavioral deficits (Cawley, 1977). The strong emphasis on content is what constitutes the racial and cultural biasing against certain ethnic groups. Children labeled as learning disabled or mentally retarded are done so on the basis of performance on a test which is really a measure of content assimilation. Webster, Schenck and Kahn (1977) note that:

> "....does a 12 year old child who correctly answers the first 70 items on the Peabody Picture Vocabulary Test and fails all subsequent items and obtains an IQ of 74 really have an intellectual potential in the borderline defective range? If the child can perform the behavior of associating an aural input with the correct response selected from a visual array 70 times, is the problem one of receptive language (and, by inference, low IQ) or does the child have a content deficiency resultant of several potential factors such as individual mood fluctuations, SES, or cultural and educational deprivation?" (p. 9)

Finally, this type of diagnostic assessment procedure is directly related to the instruction-learning process. It provides specific information based on techniques derived from experimental research in learning and memory about a child's STM capacity and processing efficiency. Further, it avoids the quantification of a hypothetical construct which is used as the primary criterion for subsequent educational and social placement.

References

Baddeley, A. The psychology of memory. New York: Basic Books, Inc., 1976.

Bjork, R. Theoretical implications of directed forgetting. In A. Melton & E. Martin (Eds.), Coding processes in human memory. Washington, D.C.: Winston, 1972.

Blankenship, A. Memory span: A review of the literature. Psychological Bulletin, 1938, 35, 1-25.

Brown, J. Some tests of the decay theory of immediate memory. Quarterly Journal of Experimental Psychology, 1958, 10, 12-21.

Brown, A., Campione, J. & Murphy, M. Keeping track of changing variables: Effects of rehearsal training and rehearsal prevention in normal and retarded adolescents. Journal of Experimental Psychology, 1974, 78, 446-453.

Bruininks, R. Auditory and visual skills related to the reading performance of disadvantaged boys. Perceptual and Motor Skills, 1969, 29, 179-186.

Cawley, J. F. Content or behavior: An issue in the assessment of specific learning disabilities. Paper presented at the Conference on Assessment in Learning Disabilities, The Howard School, Inc., Atlanta, May 1977.

Critchley, M. The dyslexic child. Springfield: Charles C. Thomas, 1970.

Crowder, R. Principles of learning and memory. Hillsdale, New Jersey: Erlbaum Associates, 1976.

Ellis, N.R. Memory processes in retardates and normals. In N. Ellis (Ed.), Handbook of mental deficiency (Vol. 4). New York: Academic Press, 1970.

Goyen, J. and Lyle, J. Short-term memory and visual discrimination in retarded readers. Perceptual and Motor Skills, 1973, 35(2), 403-408.

Graham, C. Short-term memory and syntactic structure in educationally subnormal children. Language and Speech, 1968, 11, 209-219.

Haber, R. How we remember what we see. Scientific American, 1970, 222, 104-112.

Johnson, D. and Myklebust, H. Learning disabilities: Educational principles and practices. New York: Grune & Stratton, 1967.

Klausmeier, H., Ghatala, E. and Frazer, D. Conceptual learning and development: A cognitive view. New York: Academic Press, 1974.

Merikle, P. Presentation rate and order of approximation to English as determinants of short-term memory. Canadian Journal of Psychology, 1969, 23, 196-202.

Miller, G. The arabic number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 1956, 80, 335-338.

Murdock, B. B. Human memory: Theory and data. Potomac, Maryland: Lawrence Erlbaum Associates, 1974.

Nelson, C. & Hudson, F. Predicting the reading achievement of junior high school EMR children. American Journal of Mental Deficiency, 1969, 74(3), 415-420.

Newcomer, P. & Hammill, D. D. Psycholinguistics in the schools. Columbus, Ohio: Charles E. Merrill, 1976.

Pick, A. D. Systems of perceptual motor development. In J. P. Hill (Ed.), Minnesota symposium on child development, Vol. 4, Minneapolis: University of Minnesota Press, 1970.

Samuels, S. and Anderson, R. Visual recognition memory, paired-associate learning and reading achievement. Journal of Educational Psychology, 1973, 65, 160-167.

Senf, G. & Freundl, P. Memory and attention factors in specific learning disabilities. Journal of Learning Disabilities, 1971, 4(2), 94-106.

Shankweiler, D. & Liberman, A. M. Misreading: A search for cues. In J. Kavanaugh & I. Mattingly (Eds.), Language by ear and by eye: The relationships between speech and reading. Cambridge: M.I.T. Press, 1972.

Shedd, C. Ptolemy rides again or dyslexia does't exist. Alabama Journal of Medical Sciences, 1968, 5, 481-503.

Sternberg, S. High-speed screening in human memory. Science, 1966, 153, 652-654.

Sternberg, S. Mental processes revealed by reaction-time experiments.' American Scientist, 1969, 57, 421-457.

Webster, R. E., Schenck, S. J. & Kahn. H. An individualized method for assessing the 'learning disabled' child. Paper presented at the Annual Conference of the Northeastern Educational Research Association, New York, October 1977.

Webster, R. E. Short-term memory capacity in mathematics proficient and disabled students as a function of input modality-output modality interactions. Unpublished doctoral dissertation, University of Connecticut, Storrs, 1978.